GENERAL EARTHQUAKE OBSERVATION SYSTEM

FIELD OF THE INVENTION

The present invention relates to a general earthquake observation system, and in particular relates to a computerized system for monitoring, recording and/or transmitting a wide variety of seismic signals. In a particular embodiment, the present invention relates to a portable computerized system for general seismic data acquisition purposes.

BACKGROUND OF THE INVENTION

Major functions required of a digital seismic data acquisition system include signal conditioning of analog sensor outputs, digital conversion of analog signals, external time reference, event detection, pre-event memory, data storage, operator interface, data archival and retrieval and system calibration. Such a system finds utilization for recording and analyzing all types of seismic data in the fields of seismology, geophysics, and engineering.

Previous system designs are generally more difficult to operate, have a factor sixteen less resolution, have a less than desirable digitization rate and data capacity, and/or generally not completely portable. A desirable general earthquake observation system for use in a wide variety of passive and active seismic experiments requires portability and the requisite low power requirements, a wide dynamic range, a high data resolution, a broad frequency band width, a large data storage capacity, an accurate and adjustable time standard, selectable signals from sensors, and an interactive capability permitting easy operator control and input. Unfortunately, no system is known to exist which provides all of these desirable features.

SUMMARY OF THE INVENTION

It is, therefore, a feature of the present invention to have an integrated, interactive seismic data acquisition system that provides a much greater degree of system flexibility in both performance and range of application than previously possible with conventional, hard wired systems. Further, it is a feature of the present invention to have an intelligent, seismic data acquisition system that is under computer software control in which the hardware is of modular construction and which is centrally controlled by a microprocessor. It is a further feature of the present invention to have English language, interactive operation commands and a portable system that can be operated by lessor skilled personnel.

The present invention provides a system for use in a wide range of seismic studies including: strong-motion, structural response, aftershock, reflection-refraction, teleseismic, near-surface seismic exploration, hydrofrac, and free-oscillations. The present system can be used in either an observatory setting, or as a portable, low-power recorder for extended deployment in remote locations. Some specific applications of the present system include: near-source strong-motion studies; structural vibration studies; crustal refraction; microearthquake studies; and teleseismic studies.

A particular embodiment of the present invention incorporates a plurality of hardware modules operated through a computer bus under the central control of a microprocessor operated by dynamic, and interactive software with rapid data transfer via dedicated data bus and with communication capabilities through a digital input output bus. Specific hardware modules in accordance with this specific embodiment include a signal conditioning module with software adjustable gains and antialiasing filters; an analog-to-digital module with software adjustable sampling rates, selectable data channels, and data resolution; a temporary data buffer module with software adjustable capacity and facility for communication with an external central processing unit; a high-speed mass storage buffer with software selectable operational parameters and the capability of utilizing a variety of memory media (e.g. tape, disc, bubble memory, and internal ram memory); a time control module for receiving and interpreting external time standards and deriving corrections for an internal time standard; an operator interface module for interactive display and selection of parameters used for software control of the other modules; and a system calibration and test module with software selectable input signals for calibration of the external sensors.

The above specific embodiment has a broad range of land-based applications including micro-earthquake studies at distances less than 5 km, crustal refraction studies, strong motion studies, and near-surface seismic exploration studies. It is seen that the present system accomplishes these objectives through central control with a microprocessor base microcomputer of modular design thereby providing maximum adaptability and ease of modification for different applications. In addition, the present invention provides a system having a high dynamic range and wide frequency response; offering complete portability to the extent that the entire unit can be placed under the seat of an airplane; and that is self-triggering, has low power, and can be produced at a modest cost.

Other features, advantages and objects of the present invention will be set forth in or will become apparent from the detailed description of the presently preferred embodiment set forth hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

With reference now to the figures wherein like numerals represent like elements throughout the several views:

FIG. 1 is a front elevational view of the front panel of a portable microcomputer earthquake observation system according to the present invention;

FIG. 2 is an electrical schematic block diagram of the microcomputer system illustrating system functions and corresponding hardware modules under control of a central microcomputer via a general computer bus;

FIG. 3 is a flow chart of a computer program for overall system control;

FIGS. 4A and 4B are flow charts of a computer program for performing program control of the various hardware modules;

FIG. 5 is a flow chart of a computer program for updating the output display;

FIG. 6 is a flow chart of a computer program for the input keyboard interupt routine;

FIG. 7 is a flow chart of a computer program for performing a routine associated with the analog-to-digital converter hardware module;

FIG. 8 is a map with superimposed representations of the north-south components of acceleration signals recorded at various locations;